

Research Report on Increments 6 and 7



Vic Cooley, Ph.D.
Lead Increment Scientist
ISS Payloads Office
281 244-7108

SSUAS Workshop
July 28, 2003

Docking and Expedition Timeline

Expeditions 6 and 7



Expedition 6

Expedition 7



11A Nov 24, 2002



10P Feb 2, 2003



6S Apr 26, .2003
5S May 3, .2003



11P Jun. 8, 2003



12P Aug. 30, 2003



7S Oct. 18, .2003
6S Oct. 28, .2003

ISS Expedition 6 Research Accomplishments Overview

- Completed 293 crew hrs of NASA science operations
- Research during Inc. 6 was hampered by MSG and Shuttle Program downtime
 - The MSG rack was unavailable for science use for 18 of 22 weeks of Inc. 6 resulting in delays to PFMI, CSLM, and InSPACE
 - Some science samples and hardware could not be returned as planned
 - Science samples: Protein Crystal Growth and 22 of 29 ZCG autoclaves
 - Hardware: ARCTIC 1
- 22 investigations were planned
 - 14 investigations accomplished 100% or better of planned requirements
 - Biopsy, Epstein-Barr, FOOT, Chromosome, EVARM, Mobility, PuFF, Renal Stone, Subregional Bone, MAMS, SAMS, CEO, EarthKAM, MISSE
 - Eight Investigations accomplished less than 100% of requirements

MSG	{	– MSG-PFMI	0 %	processing delayed w/o loss of science
	– MSG-CSLM-2	0 %	processing delayed w/o loss of science	
	– MSG-InSPACE	48 %	processing delayed w/o loss of science	
Orbiter	{	– PCG-STES (four investigations)	0 %	active, return at risk, crystals may dissolve
	– ZCG	75 %	all samples processed, seven highest priority samples returned	

Four investigations accomplished greater than 100%

Inc. 6	Investigation title	Investigator/ Affiliation	Payload	Remarks
175	Foot/Ground Reaction Forces During Space Flight	Peter Cavanagh	FOOT	Exp. 6: Four sessions planned, 7 completed plus 1 additional modified session. Sensor problems resulted in loss of one muscle sensor during one of the original 4 and all of the extra sessions.
150	A Study of Radiation Doses Experienced by Astronauts in EVA	Ian Thomson, Thomson & Nielson Electronics LTD	EVARM	Exp. 6: 8 baselined (including 2 11A mated EVA's x two crewmembers) datatakes plus nine extra background readings. EVA readings are more valuable than background readings. All extra readings were background readings, hence not counted linearly.
113	The Effects of EVA and Long-term Exposure to Microgravity on Pulmonary Function	John West, University of California San Diego	PUFF	Exp. 6: Eight baselined takes (including Pre/Post for two stage EVA's), plus one unplanned take.
200	Earth Knowledge Acquired by Middle Schools	Sally Ride, University of California San Diego	EARTH-KAM	Exp. 6: One planned session (4 days) plus one extra sesion (5 days).

Expedition 6 and 7 Research Accomplishments

Facilities

		Increment 6		Increment 7			
		11A	6S	11P	12P	7S	
		(11/02)	(4/03)	(6/03)	(8/03)	(10/03)	
Facilities							
HRF Rack 1							
	<i>Cindy Haven</i>						
EXPRESS Rack 1							
	<i>Mike Danford</i>						
EXPRESS Rack 2 (A)							
	<i>Mike Danford</i>						
EXPRESS Rack 4							
	<i>Mike Danford</i>						
EXPRESS Rack 5							
	<i>Mike Danford</i>						
ARCTIC 1							
	<i>Tom Goodwin</i>						
ARCTIC 2							
	<i>Tom Goodwin</i>						
MSG							
	<i>Charles Baugher</i>						
EXPRESS Rack 3 (A)							
	<i>Mike Danford</i>						

Legend:	
Active	
Inactive	

Office of Space Flight

Expedition 6 and 7 Research Accomplishments



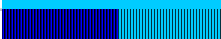
		Increment 6		Increment 7				
		11A	6S	11P	12P	7S		
		(11/02)	(4/03)	(6/03)	(8/03)	(10/03)		
Code M								
Crew Earth Obs								
	<i>Kamlesh Lulla</i>							
EarthKAM								
	<i>Sally Ride</i>							
MISSE 1/2								
	<i>William Kinard et al.</i>							
Educational Payload Operations								
	<i>Cindy McArthur</i>							
ESTER								
	<i>Greg Byrne</i>							
Hand Posture Analyzer (HPA)								
	<i>Vittorio Cotronei</i>							
SPHERES								
	<i>David Miller</i>							

Active on orbit payload or investigation.	
Inactive on orbit payload or investigation.	
Candidate payload, active or inactive.	

Expedition 6 and 7 Research Accomplishments

Human Life Science

		Increment 6		Increment 7			
		11A	6S	11P	12P	7S	
		(11/02)	(4/03)	(6/03)	(8/03)	(10/03)	
Human Life Sciences							
Subregional Bone							
	<i>Thomas Lang</i>						
Interactions							
	<i>Nick Kanas</i>						
Biopsy							
	<i>Robert Fitts</i>						
PuFF							
	<i>John West</i>						
Renal Stone							
	<i>Peggy Whitson</i>						
Foot							
	<i>Peter Cavanagh</i>						
EVARM							
	<i>Ian Thomson</i>						
Mobility							
	<i>Jacob Bloomberg</i>						
Epstein-Barr							
	<i>Raymond Stowe</i>						
Chromosome							
	<i>Gunter Obe</i>						

Legend:	
Active on-orbit investigation	
Preflight/postflight investigation.	
Candidate payload, active or inactive.	

Expedition 6 and 7 Research Accomplishments

Physical Science

		Increment 6		Increment 7			
		11A	6S	11P	12P	7S	
		(11/02)	(4/03)	(6/03)	(8/03)	(10/03)	
Physical Science Research							
MAMS							
	<i>Richard DeLombard</i>						
SAMS							
	<i>Richard DeLombard</i>						
PCG-STES-10							
	<i>Dan Carter et al.</i>						
CBOSS							
	<i>Neal Pellis et al.</i>						
MSG/SUBSA							
	<i>Aleksander Ostrogorsky</i>						
MSG/PFMI							
	<i>Richard Grugel</i>						
MSG/InSPACE							
	<i>Alice Gast</i>						
MSG/CSLM							
	<i>Peter Voorhees</i>						
ISSI							
	<i>Richard Grugel</i>						
MFMG-T							
	<i>John Pojman</i>						

Active on-orbit payload or investigation.	
Inactive on-orbit payload or investigation.	
Candidate payload, active or inactive.	

Expedition 6 and 7 Research Accomplishments

Space Product Development

		Increment 6		Increment 7			
		11A	6S	11P	12P	7S	
		(11/02)	(4/03)	(6/03)	(8/03)	(10/03)	
Space Products Development							
ZCG							
	<i>Al Sacco</i>						
MEPS							
	<i>Dennis Morrison, Ben Mosier, Allison Ficht, Frank Little</i>						
PGBA/CGBA							
	<i>Alex Hoehn</i>						

Active on-orbit payload or investigation.	
Inactive on-orbit payload or investigation.	
Candidate payload, active or inactive.	

Backup

- Research Accomplishment Details through Inc. 6

Research Accomplishment Details

Exp. / % Accomplished												
0	1	2	3	4	5	6	Investigation title	Investigator/Affiliation	Payload	Remarks		
				100			Development and Function of the Avian Otolith System in Normal and Altered Gravity Environments	J. David Dickman, Washington University	ADF			
				100			Skeletal Development in Embryonic Quail	Stephen Doty, Hospital for Special Surgery	ADF			
				135			Biomass Processing System Technology Validation Test	Robert Morrow, Orbital Technology Corp.	BPS	Exp. 4: 30-day mission extension allowed additional wheat growth cycles and related operations.		
				185			Photosynthesis Experiment and System Testing Operation	Gary Stutte, Dynamac Corp.	BPS	Exp. 4: 30-day mission extension allowed additional wheat and Brassica growth cycles and related operations.		
		100	80	Bonner Ball Neutron Detector	Tateo Goka, National Space Development Agency of Japan	BBND	Exp 2: Delayed HRF W/S activation prevented data downlink, data stored on disks. Exp 3: 20% data loss due to defective hard drive.					
		40		100	100	Effect of Prolonger Spaceflight on Human Skeletal Muscle	Robert Fitts	BIOPSY				
						Dosimetric Mapping	Gunther Reitz, DLR Institute of Aerospace Medicine	DOSMAP	Exp. 2: UOP tripping interfered with experiment operations. Time dependent deployment of passive dosimeters delayed due to lack of crew time.			
				100	100	Space Flight Induced Reactivation of Epstein-Barr Virus	Raymond Stowe	EPSTEIN-BARR				
						175			Foot/Ground Reaction Forces During Space Flight	Peter Cavanagh	FOOT	Exp. 6: Four sessions planned, 7 completed plus 1 additional modified session. Sensor problems resulted in loss of one muscle sensor during one of the original 4 and all of the extra sessions.
						100			Chromosomal Aberrations in Blood Lymphocytes of Astronauts	Gunther Obe	Chromosome	
				90	87	150	A Study of Radiation Doses Experienced by Astronauts in EVA	Ian Thomson, Thomson & Nielson Electronics LTD	EVARM	Exp. 5: 7 of 8 planned EVA exposures completed, additional background data obtained. Exp 5: UF2 EVA sessions completed, although not timed. Exp. 6: 8 baselined (including 2 11A mated EVA's x two crewmembers) datatakes plus nine extra background readings. EVA readings are more valuable than background readings. All extra readings were background readings, hence not counted linearly.		

Research Accomplishment Details

continued

0	1	2	3	4	5	6	Investigation title	Investigator/Affiliation	Payload	Remarks
		109	109	100			Effects of Altered Gravity on Spinal Cord Excitability	Doug Watt, McGill University, Montreal	HREFLEX	Exp. 2, 3: Additional in-flight and postflight sessions were completed at PI request.
		83	61	87	83		Crewmember and Crew-Ground Interactions During ISS Missions	Nick Kanas, University of California and VA Medical Center	INTERACTIONS	Exp. 5: Missed sessions couldn't be scheduled preflight due to joint ops or progress docking constraints. Improvement may be accomplished with more payloads time during weeks of and Progress arrival/departure and STS docked operations. Lack of consistent data collection may confound science return.
					100		Test of Midodrine as a Countermeasure against Postflight Orthostatic Hypotension	Janice Meck	MIDODRINE	
					100	100	Promoting Sensorimotor Response	Jacob Bloomberg	MOBILITY	
			94	100	100	113	<u>Generalizability: A Countermeasure to Mitigate</u> The Effects of EVA and Long-term Exposure to Microgravity on Pulmonary Function	John West, University of California San Diego	PUFF	Exp. 3: Not all post-EVA data collections occurred on requested day. Exp. 6: Eight baselined takes (including Pre/Post for two stage EVA's), plus one unplanned take.
			70	100	90	100	Renal Stone Risk During Space Flight: Assessment and Countermeasure Validation	Peggy Whitson, NASA-JSC	RENAL STONE	Exp. 5: Final session was completed outside the 30-days-before-landing constraint.
		100	100	100	100	100	Sub-regional Assessment of Bone Loss in the Axial Skeleton in Long-Term Space Flight	Thomas Lang, University of California San Francisco	SUBREGIONAL BONE	
		60					Organ Dose Measurements Using a Phantom Torso	Francis Cucinotta, NASA-JSC	TORSO	Exp. 2: UOP tripping interfered with experiment operations. Time dependent deployment of passive dosimeters delayed due to lack of crew time. Failure of one experiment component (CPDS).
			100	100	100		Effect of Microgravity on the Peripheral Subcutaneous Veno-Arteriolar Reflex in Humans	Anders Gabrielsen, National University Hospital, Copenhagen	XENON1	
			100				Evaluation of Ovarian Tumor Cell Growth and Gene Expression	Jeanne Becker, University of South	CBOSS	
			100	100			Renal Cell Differentiation and Hormone Production from Human Renal Cortical Cells	Timothy Hammond, Tulane University Medical Center	CBOSS	Exp. 4: All objectives met, but cold stowage temperature anomalies during Exp 4 may compromise some science.
			100				Use of NASA Bioreactor to Study Cell Cycle Regulation Mechanisms of Colon Carcinoma Metastasis in Microgravity	J. Milburn Jessup, University of Texas Health Science Center,	CBOSS	

Research Accomplishment Details

continued

Exp. / % Accomplished							Investigation title	Investigator/Affiliation	Payload	Remarks
0	1	2	3	4	5	6				
			100				PC12 Pheochromocytoma Cells: A Proven Model System for Optimizing 3-D Cell Culture Biotechnology in Space	Peter Lelkes, Drexel University	CBOSS	
				100			Production of Recombinant Human Erythropoietin by Mammalian Cells Cultured in Simulated Microgravity	Arthur Sytkowski, Harvard Medical School	CBOSS	Exp. 4: All objectives met, cold stowage temperature anomalies may compromise some science.
				100			Simulated Microgravity Antigen Synthesis in Tonsillar B Cells	Joshua Zimmerberg, National Institutes of Health	CBOSS	Exp. 4: All objectives met, cold stowage temperature anomalies may compromise some science.
			100				Dynamically Controlled Protein Crystal Growth	Larry DeLucas, University of Alabama, Birmingham	DCPCG	
	90	100		55			Physics of Colloids in Space	David Weitz, Harvard University	EXPPCS	Exp. 4: Despite rack anomalies and less than optimal comm coverage, esp. early, and hardware failure in Exp 4, most objectives accomplished and additional unplanned science objectives were met.
	80	90	95	90	100		Microgravity Acceleration Measurement System	Richard DeLombard, NASA-GRC	MAMS	Exp. 5: Sporadic comm coverage, MCOR anomalies and rack power-downs prevented collection of all planned data.
					117	0	Pore Formation and Mobility Investigation	Richard Grugel	MSG-PFMI	Exp 5: One extra sample processed. Exp. 6: MSG downtime prevented resumption of PFMI processing.
					50		Solidification Using Baffles in Sealed Ampoules	Alexander Ostrogorsky	MSG-SUBSA	Exp. 5: Five of ten required ampoules successfully processed. Two may not have achieved melt temperature at the seed due to software issues, one ampoule cracked during processing due to supercooling caused by encapsulant, two other ampoules cracked when removed from their stowage tubes.
							Coarsening in Solid-Liquid Mixtures 2	Peter Voorhees	CSLM-2	Exp. 6: MSG downtime prevented processing of two engineering samples.
						0				
						48	Investigating the Structure of Paramagnetic Aggregates in Colloidal Emulsions	Alice Gast	MSG-InSPACE	Exp. 6: Thirteen of 27 planned runs completed due to MSG downtime.

Research Accomplishment Details

continued

Exp. / % Accomplished							Investigation title	Investigator/Affiliation	Payload	Remarks
0	1	2	3	4	5	6				
100	100	100		100			Protein Crystal Growth-Enhanced Gaseous Nitrogen Dewar	Alex McPherson, University of California	PCG-EGN	
		100		100	100	0	Facility-Based Hardware Science and Applications	Dan Carter, New Century Pharmaceuticals, Huntsville	PCG-STES	Exp. 6: Indefinite ability to return processed samples may result in full loss of science.
		100		100	100	0	Improved Diffraction Quality of Crystals	Craig Kundrot, NASA-MSFC	PCG-STES	Exp. 6: Indefinite ability to return processed samples may result in full loss of science.
						0	Crystal Growth: Model System/material Science	Bill Thomas, U of Alabama, Huntsville	PCG-STES	Exp. 6: Indefinite ability to return processed samples may result in full loss of science.
						0	Regulation of Gene Expression	Gerald Bunick, Oak Ridge National Laboratory	PCG-STES	Exp. 6: Indefinite ability to return processed samples may result in full loss of science.
		100		100	100		Vapor Equilibration Studies	Aniruddha Achari, NASA-MSFC	PCG-STES	
				100	100			Gloria Borgstahl	PCG-STES	
				100	100			Geoffrey Chang	PCG-STES	
				100	100			Barbara Golden	PCG-STES	
				100	100			Ron Kaplan	PCG-STES	
	65	90	90	90	100		Space Acceleration Measurement System	Richard DeLombard,	SAMS	Exp. 5: Sporadic comm coverage, MCOR
		100					Crystallization of Human Low Density Lipoprotein	M. Baumstark, University	APCF	
		100					Crystallization of Rhodopsin in Microgravity	W. de Grip, University of	APCF	
		100					Effect of Different Growth Conditions on the	R. Giege, CNRS	APCF	
		100					Crystallization of the Next Generation of	J. Martial, University of	APCF	
		100					Testing New Trends in Microgravity Protein	F. Otalora, University of	APCF	
		100					Solution Flows and Molecular Disorder of Protein	S. Weinkauff, Technical	APCF	
		100					Extraordinary Structural Features of Antibodies	L. Wyns, Free University	APCF	
		100					Protein Crystallization in Microgravity, Collagen	A. Zagari, University of	APCF	
	80	95		100			Active Rack Isolation System - ISS Characterization Experiment	Glenn Bushnell, Ian Fialho, The Boeing	ARIS-ICE	Despite delayed start and some hardware anomalies, ARIS characterization was
	100	100	100	100	100	100	Crew Earth Observations	Kamlesh Lulla, NASA-	CEO	
		100	100	100			Earth Knowledge Acquired by Middle Schools	Sally Ride, University of California San Diego	EARTHKAM	Exp 5: Not originally scheduled for this Exp, also did ESTER (Exp 7) get-aheads. Exp. 6: One planned session (4 days) plus one extra session (5 days).
				100	100		Education Outreach	Patience Smith, NASA-JSC	EPO	

Research Accomplishment Details

continued

0	Exp. / % Accomplished						Investigation title	Investigator/Affiliation	Payload	Remarks
	1	2	3	4	5	6				
	20	100					Middeck Active Control Experiment-Reflight Program	Rory Ninneman, Air Force Research Lab, Albuquerque	MACE-II	Early payload planned for Exp 1, extended to Exp 2. All primary objectives met.
			100	100	100	100	Materials on International Space Station Experiment	William Kinard, NASA-LaRC	MISSE	Return of this external payload has been delayed, but no science loss is expected.
	100						Soybean and Corn Seed Germination in Space	Howard Levine, Dynamac Corporation	SEEDS	
		100		100	100		Microgravity Impact on Plant Seed-to-Seed Production	Weijia Zhou, Wisconsin Center for Space	ADVASC	Exp 2: Return accelerated from 7A.1 to 7A due to mission extension.
				100			Commercial Biomedical Testing Module	Ted Bateman, Bioserve Space Technologies	CBTM	
100							Neurolab Reflight	Timothy Hammond, Tulane University Medical Center	CGBA	
100							Effects of Spaceflight of Drosophila Neural Development	Haig Keshishian, Yale University	CGBA	
		10		100			Commercial Generic Biopressing Apparatus	David Klaus, Bioserve Space Technologies	CGBA	Exp 2: Hardware failed after 3 weeks. Reflown successfully on Exp 4.
		100		100			Commercial Protein Crystal Growth	Larry DeLucas, University of Alabama, Birmingham	CPCG-H	Exp 2: On-orbit duration about twice as long as planned due to mission extension.
			100				Long Duration HDTV Camcorder Experiment-Video	Ben Mason, Dreamtime Holdings, Inc	DREAMTIME	
					100		Microencapsulation Electrostatic Processing System	Dennis Morrison	MEPS	Exp. 5: All samples processed. One sample tube was difficult to insert, but was successful upon third attempt.
					0		Plant Generic Bioprocessing Apparatus	Alex Hoehn	PGBA	Exp. 5: Plants did not mature.
					75		Liver Cell Function in Microgravity	Albert Li	STELSYS	Exp. 5: Metabolite fluid inadvertently withdrawn and separated from tissue for one of four sample batches.
				100	100	75	Zeolite Crystal Growth	Al Sacco, CAMMP, Northeastern University	ZCG	Exp. 5: Two operations, one on each stage, successful. Supported by ARIS for the first 20 hrs. Exp. 6: The seven top priority autoclaves, of nineteen planned, were returned, due to transport limitations. Ten spare autoclaves were also processed but were unable to be returned.
100	80	85.9	96	101	92.5	80	Cumulative average:			

B2-6 OPERATIONS PRIORITIES [RC]

All ISS operations are prioritized according to the following criteria in the following order:

- A. TASKS THAT ARE NECESSARY TO (OR WHICH SUPPORT) CREW AND/OR STATION SURVIVAL.
- B. TASKS THAT ARE NECESSARY TO ENSURE ELEMENT SURVIVAL.
- C. TASKS THAT PRESERVE THE ABILITY TO RETURN TO STATION FOR RESUPPLY, CREW RETURN AND/OR ASSEMBLY.
- D. CREW ROTATION
- E. TASKS THAT PREVENT LOSS OF OR RE-ESTABLISH SINGLE-FAULT TOLERANCE OF A CRITICAL FUNCTION.
- F. TASKS THAT ARE NECESSARY TO MAINTAIN ORBITER and soyuz RETURN CONFIGURATION.
- G. TASKS THAT INCREASE FAULT TOLERANCE; REESTABLISH A DEGRADED FUNCTION OR ADD NEW STATION CAPABILITIES.
- H. TASKS THAT MUST BE COMPLETED TO AVOID IMPACTING NOMINAL ASSEMBLY OF THE NEXT FLIGHT.
- I. PAYLOAD OPERATIONS
- J. ALL OTHER TASKS

The above priorities were established based on programmatic priorities of first achieving and maintaining crew and vehicle safety for both the Station and the orbiter, achieving successful completion of the current mission, and minimizing the impact to future missions.